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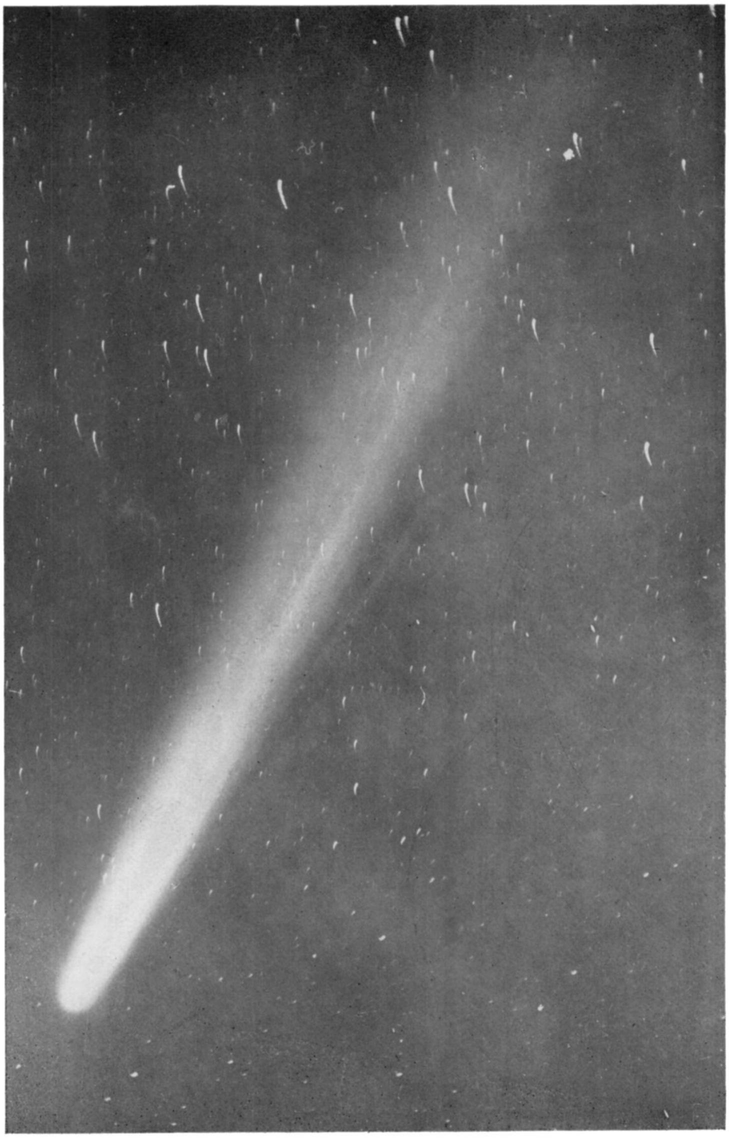

FIG. I.—COMET HALLEY, MAY 9, 1910.
14h 47m — 15h 47m P.S.T.
Willard 5-inch lens.

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PHOTOGRAPHS OF HALLEY'S COMET MADE AT THE LICK OBSERVATORY.

By HEBER D. CURTIS.

In the interval from September 12, 1909, to July 7, 1910, Halley's Comet was photographed at the Lick Observatory on ninety-five nights, with a total of three hundred and seventy negatives, distributed as follows:—

Crossley reflector	206 plates
Willard 6-inch lens	66 "
Willard 5¼-inch lens	52 "
Zeiss planar	25 "
Lantern lens	19 "
Dallmeyer 6-inch lens	2 "

The constants for the various instruments used are as follows:—

Instrument.	Aperture.	Focal length.	1 inch =	Focal ratio.
Crossley	36.00 in.	210.1 in.	16′.4	1 : 5.8
Willard 6-inch	6.00	30.8	1°.9	1 : 5.3
Dallmeyer 6-inch	6.00	32.5	1 .8	1 : 5.5
Willard 5¼-inch	5.25	25.9	2 .2	1 : 4.9
Zeiss planar	1.62	6.1	9 .4	1 : 3.9
Lantern lens	1.62	5.0	11 .6	1 : 3.0

The Dallmeyer lens, mounted on the Crocker photographic telescope, was used for only two plates. A few plates were taken also with the Willard six-inch camera on the same mounting, but after February 11th the latter lens was removed from the Crocker telescope, and all the cameras mentioned above, with the exception of the Dallmeyer, were mounted on the tube of the Crossley reflector. The earlier plates taken with the Crossley were obtained by guiding on a star and moving the cross-wires one second of arc at intervals calculated to allow for the motion of the comet in right ascension and declination. As soon as the comet became bright enough for the purpose a guiding telescope of 3.5 inches aperture and 211.5 inches focal length was employed, at first with illuminated wires and later with dark wires when the brightness of the nucleus permitted this course. In anticipation for the need of guiding on the comet with the telescope as a whole instead of the usual moving plate the reflector had been dismounted in January and special anti-friction roller bearings installed in both the polar and declination axes. These worked perfectly, and the guiding with the long finder was entirely satisfactory as regards responsiveness and delicacy, though the moving parts weigh over six tons. As the long finder is of practically the same focal length as the reflector, no flexure was experienced, and the guiding for the smaller instruments mounted on the massive tube was naturally far more accurate than would have been possible with the shorter finder of the Crocker telescope.

Several different brands of plates were used during the work; the earlier plates were in general Seed 27 or Cramer Crown. When the tail developed sufficiently, Cramer Instantaneous Isochromatic plates were tried because the comet was relatively so strong in visual light. These plates gave on the whole the best results during this period, and were used with but few exceptions throughout the time of greatest brightness. After the comet became fainter Lumiere "Sigma" plates were employed for the most part. The guiding telescope was so set that the Crossley plates show the head and about 40′ of the tail; the Willard lenses were mounted on the cube of the reflector tube so as to displace the head about six degrees from the center of the plate and take in twelve to fifteen degrees of the tail; the short focus lenses were mounted at the upper end of the tube. When the tail became too long to be recorded with the Zeiss and lantern lenses (extreme fields of about 45° and 35° respectively) the latter was shifted so as to take in only the outer and fainter portions of the tail. When the time available for exposure permitted, two shorter exposures were made with the Willard 6-inch simultaneously with a long exposure with the 5¼-inch. Four or more plates were generally made with the reflector on each night. One or two of these were quite short to obtain the details of the inner coma and nucleus, one or two were made with exposures from five to fifteen minutes, and another with an exposure as long as possible, the shorter exposures being made at times when the commencement of morning or evening twilight would have rendered a long exposure unsafe. Five, and on a few occasions six, plates were exposing at once, the one guiding serving for all the instruments, with due precautions as to shutting off exposure while plates were being changed. The plates taken while the lenses were mounted on the Crocker telescope were made by C. P. Olivier, Fellow, who later assisted in guiding for many of the plates taken with the Crossley and attached cameras.

It is proposed to publish later a complete list of all the Lick Observatory photographs of Halley's Comet with more detailed measurements of the features of the head, position-angles of the tail, structure of the envelopes, etc. In this preliminary paper space permits only a brief summary of some of the more salient points in this practically unbroken photographic record, with notes on a few of the more striking plates.

NUCLEUS.

It is probable that the nucleus was sharp and stellar throughout this portion of the apparition period, though the photographic record shows a number of marked deviations from this condition,—deviations perhaps more apparent than real. On a number of dates when the head was evidently in a condition of intense activity no sharp central condensation appears even on short exposures, the whole inner coma being so bright as to mask entirely on the photographic plate any nucleus, if such existed. It is evident that the decision as to the existence of a stellar nucleus on such doubtful dates must rest with visual observations made with large refractors. A few notes will show the variations observed photographically:—

1909, Sept.	12	Nucleus 3″ to 4″	= 6000 miles
	13	3	= 5000 "
	22	2	= 2900 "
Nov.	14	3	= 2400 "
Dec.	13	9	= 5600 "

1910, Jan.	7	Nucleus 4″	= 2600	miles
Feb.	4	7	= 5500	"
Mar.	3	4	= 4000	"
Apr.	12	10	= 6400	"
	23	5	= 2300	"
May	1	4	= 1400	"
	5	3	= 800	"
	9	5	= 1000	"
	1[illegible]	10+		
	14	None		
	15	None		
	20	7″	= 400	"
	22	4	= 300	"
	23	3	= 290	"
June	1	4	= 1000	"
	11	6	= 2300	"

Dr. AITKEN's measure of 2″.6 on May 10th would correspond to an actual diameter of about 470 miles.

COMA.

The inner coma and parts immediately about the nucleus have varied greatly from night to night. Small sharp jets have been frequent, on several occasions showing a beautiful spiral effect. Bright, strong appendages and wings were frequent at the time of greatest brightness, generally asymmetrical and irregular. The phenomena have been exceedingly varied; in fact, so intricate are the details of the head on many of the plates that any verbal description is difficult and inadequate. It is hoped that it may be possible to publish later a fairly complete series of reproductions covering the more interesting plates. Figure II[1] shows the remarkable nuclear appendages on the morning of May 14th (civil date). At this time the head and envelopes were markedly asymmetrical, the south side being much the stronger. The nucleus appears elongated, and from its rear proceed two remarkable wings nearly as bright as the nucleus itself; one of these is almost in the axis of the tail and is about 50″ long; the other makes an angle of 59° with the axis of the tail and is 70″ in length. An interval of nearly fifty minutes separates the times of mid-exposure for the first and last Crossley plates of this date, but there is very

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[1] Unfortunately these appendages, though very distinct on the negatives, can be made out only with great difficulty in the published cut.

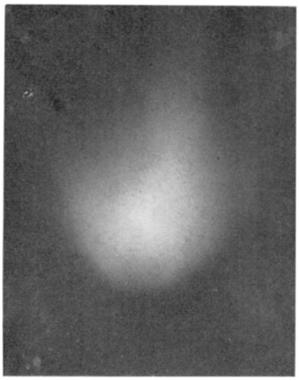

FIG. II.
May 13, $15^h\ 58^m\ 30^s$ P.S.T.
Crossley Reflector.

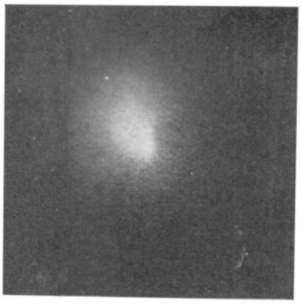

FIG. III.
May 23, $8^h\ 19^m$ — $8^h\ 20^m$ P.S.T.

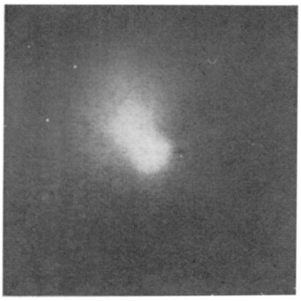

FIG. IV
May 23, $10^h\ 17^m$ — $10^h\ 19^m$ P.S.T.

Crossley Reflector, enlarged three times.

little if any change apparent in the appendages in this interval.

There are numerous cases where the plates of a given date show evidence of change and movement in the parts about the nucleus, but time has not yet permitted measurement and discussion of such plates. A case of very rapid change, almost explosive in character, is illustrated in Figures III and IV. Both plates were taken with the Crossley reflector on the evening of May 23d; the first was exposed one minute and the second two minutes, one hour and fifty-nine minutes apart. On the former plate the nucleus is quite sharp at the rear, and strong jets proceed from it on the side toward the Sun at an angle of 60° with the axis of the tail. These jets give a spiral effect to the head and are so bright at the nucleus that this appears wedge-shaped. In the next figure very bright growths, roughly spherical, have formed on each side of the nucleus, with a slightly fainter patch at the rear which joins the two globes of matter. From edge to edge the new growth measures $37'' = 3{,}570$ miles. The photographic diameter of the brightest part of the nucleus on the first plate is $3'' = 290$ miles; this may well be considerably larger than the true nucleus. A plate exposed from 8:31 to 8:49 P. S. T. shows the nucleus as still sharp and with no trace of the appendages. On the next plate, exposed from 8:55 to 9:55 P. S. T., the head is so bright as to mask considerably any details about the nucleus, which appears less sharp and roughly spherical, with an estimated diameter of $12'' = 1{,}160$ miles. The succeeding plate was exposed for ten seconds at 10:15 P. S. T. The nucleus here is sharp; small but faint traces of the outer parts of the new growths can be seen, apparently detached from the nucleus. These globular appendages seem then to have reached their full growth in the interval of about fifty minutes from 9:30 to 10:18 P. S. T., though the interval may be considerably shorter than this. Under this assumption the lower limit of the velocity of movement outward within $20''$ of the nucleus was 0.88^{km} per second, and it may well have been considerably higher. It would be of interest to trace this growth farther and to search for the remnants of this formation along the tail on the following day. May 24th, however, was the only date between May 20th and June 12th when clouds entirely prevented photographic observations, and the plates of May 25th show no condensations or anomalous features in the tail at some distance from the head.

The type form of the head has been that showing interlacing streamers and envelopes, fairly stable in character and not changing with great rapidity. On such a typical plate there will be in general three envelopes, with fairly well-marked boundaries. A fine plate taken with the Crossley on the morning of May 5th (civil date) shows envelopes more symmetrical than usual; the brightest envelope has its vertex 40″ from the nucleus; the second 80″; the third, which is very much fainter, at 140″. Outside of this can be glimpsed still fainter matter, making the total diameter of the head across the nucleus about 8′ = 137,000 miles. On the plates of May 14th (civil date) the head is remarkable for its lack of symmetry. The envelopes are confused and interlacing; the south side of the head is much stronger; irregular wings form the continuation of the brighter inner envelope and extend to a distance of 18′ from the nucleus on the southern side; a curious vacant spot 2.5′ in diameter is left by the curving streamers on the side toward the Sun and slightly displaced to the north. The diameter of the head across the nucleus is 15′ = 118,000 miles; the central part of the tail is dark. On May 23d the head is made up of spiral streamers, giving a "pin-wheel" effect. After passing the Sun in May a new feature developed in the coma in the shape of a bright spherical halo or aureola, which apparently is distinct in material and formation from the regular envelopes. On May 23d and 26th the total recorded photographic diameter of this halo was 34′ = 194,000 miles, and it was frequently so bright as to blot out many of the details of the inner coma.

The measured photographic diameters of the head of the comet are subject, of course, to the varying exposure conditions, and for a study of the variation in the size of the head as it approached the Sun such results must be used with caution. For the fainter, outer portions of the head rapid, short-focus lenses will give the most reliable data, and even with these it is probable that visual observations with large instruments will be the more trustworthy, unless long-exposure times are a possibility. The improvements in the telescope

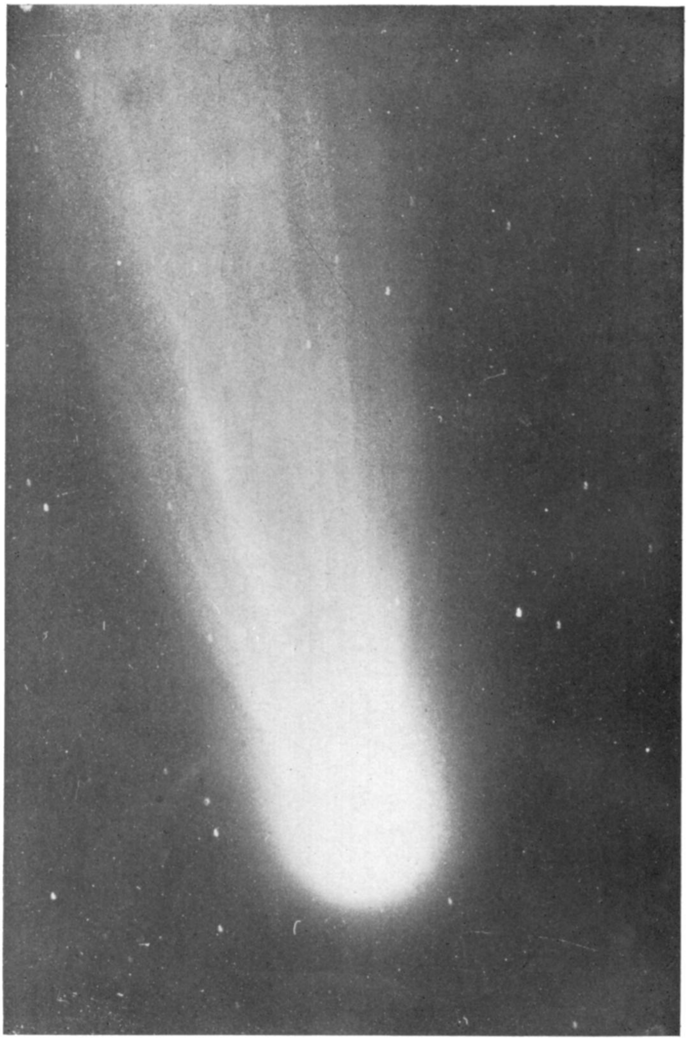

FIG. V.—May 1, $15^h\,42^m$ — $16^h\,5^m$ P.S.T.
Crossley Reflector.

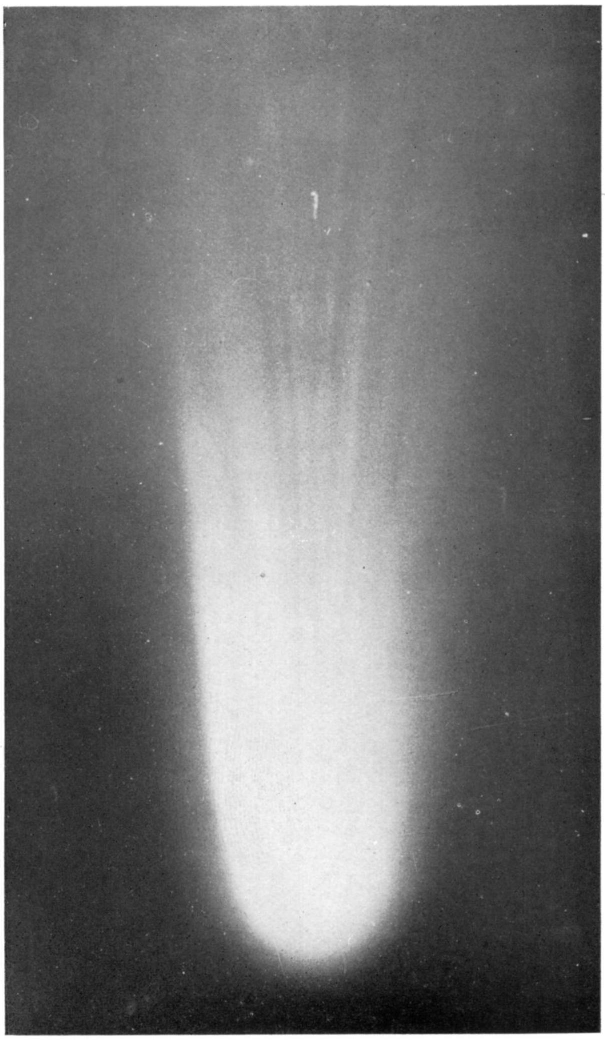

Fig. VI.—May 5, $15^h\ 17^m$ — $15^h\ 53^m$ P.S.T.
Crossley Reflector.

bearings were not completed in time to make the taking of such small-scale photographs a possibility during the time when guiding by an auxiliary telescope was impossible owing to the faintness of the comet, but it is expected to secure a series of photographs illustrating the increase in diameter as the comet recedes from the Sun. The most reliable evidence as to the size of the halo about the head in December is that given by Dr. AITKEN's measure of 15′ ($\Delta = 1.36$) = 550,000 miles. The following table gives the recorded photographic diameters on a number of selected dates:—

1909,	Sept.	12	13,000	miles
	Dec.	14	220,000	"
1910,	Jan.	7	79,000	"
		28	181,000	"
	Feb.	4	141,000	"
		11	170,000	"
		28	153,000	"
	Apr.	19	129,000	"
		28	118,000	"
	May	1	122,000	"
		5	161,000	"
		23	194,000	"
		31	315,000	"
	June	2	308,000	"
		8	340,000	"

TAIL.

The portions of the tail near the head have shown great variety and frequent change. Before May 18th the center is generally marked by a dark lane and much of the streamer effects seem to come from the envelopes. Later, the center was more usually occupied by streamers, frequently in a forked or fan effect, proceeding from the nucleus; on June 10th the center of the tail was again dark and the two main streamers appear to come from the ends of the bright inner envelope. The streamer effect near the head is shown in the Crossley plates reproduced in Figues V and VI, though much of the delicacy and beauty of the original negatives is naturally lost in the process of reproduction. Before May 18th the results from the portrait and short-focus lenses show in general a tail of the streamer type, usually quiescent and frequently entirely featureless beyond 5° from the head. Figure I gives a good idea of the appearance of the tail at this time.[1] The southern edge has almost always appeared as stronger and fairly sharply defined, fading out to invisibility on the northern side. During this period also the envelopes frequently curve back into the main tail and interlace with the nuclear streamers. The lantern lens camera showed on the morning of May 6th (civil date) a fine tail 28° long, which has a great fork commencing at 8° from the head; at 24° from the head the extreme width is 4°. On June 1st the short-focus lenses show a tail 27° long, 3° wide at the outer end, and slightly curved to the north; this slight curve is seen on later plates also. Since May 25th the tail has shown much greater activity than it displayed earlier, and numerous instances are afforded for determining the amount of the motion of recession along the tail. Perhaps the most striking case is that afforded by the plates of June 6th, 7th, and 8th, of which the plates of June 6th and June 7th are reproduced in Figures VII and VIII.

The striking feature on June 6th was the anomalous streamer of great intensity to the south of the main tail; it starts at 1°.61 from the nucleus and its head is rounded and quite sharply defined; it makes an angle of roughly 15° with the main tail and is traced on the Zeiss plate to a distance of 16° from the nucleus. No trace of this great streamer is shown on the plates of June 5th, though there is a small streamer near the nucleus which may have been the source, and its sudden formation is something of a puzzle unless it is assumed that it may be the central part of the tail of June 5th displaced or rotated around to the south. Its brightness, however, and the enormous velocities necessary to form the new central portion of June 6th are against this hypothesis. The streamer has a slightly twisted and spiral appearance, with faintly marked convolutions. On the next night, June 7th, this streamer has moved over till it lies approximately in the axis of the tail; the spiral appearance has increased so that it now has a pronounced zig-zag effect. The strong central formation of the 6th has also moved out, and the remarkable fact is that this has also assumed a zig-zag shape and its convolutions are *parallel* to those of the

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[1] The small hooks seen on the star trails are not due to defects in guiding, but to the effects of differential refraction at the low altitude to which the exposure was frequently continued.

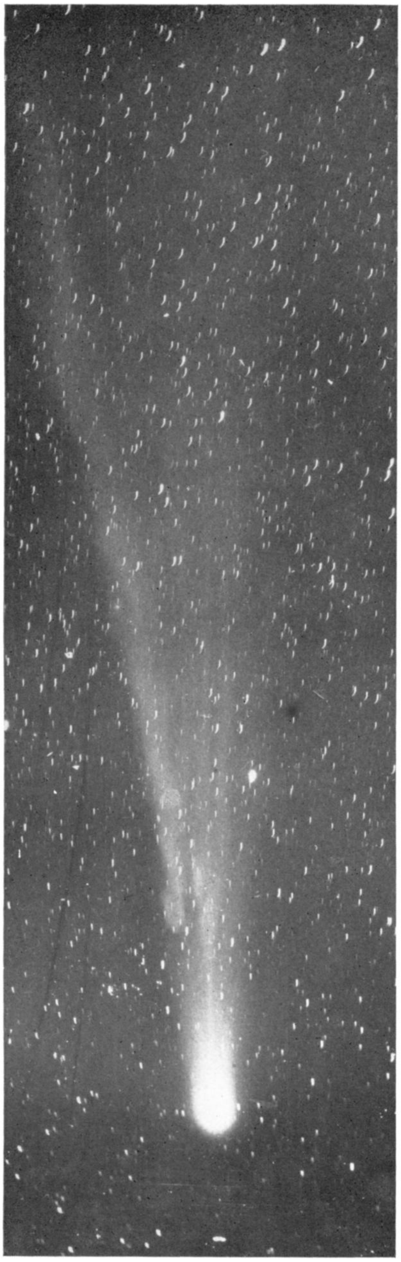

Fig. VII.
June 6, 8^h 50^m — 10^h 55^m P.S.T.

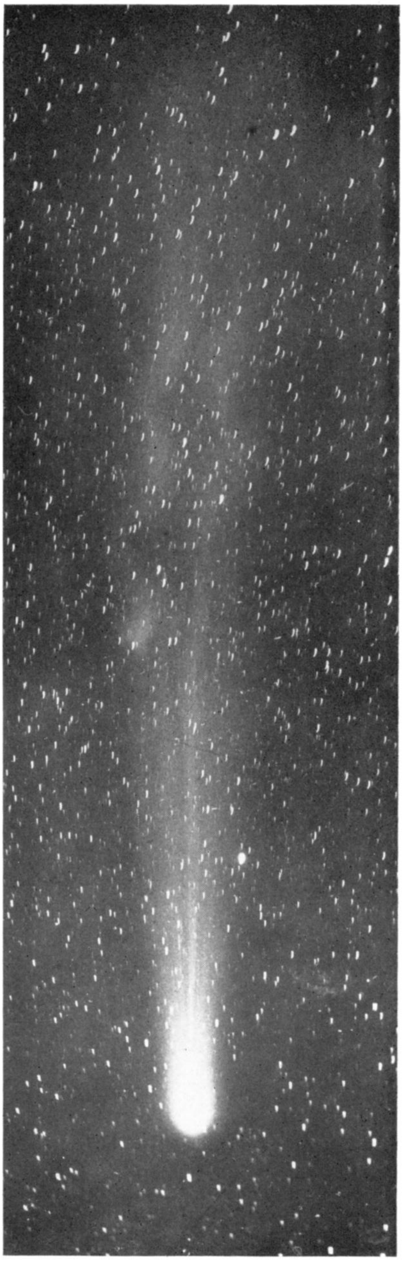

Fig. VIII.
June 7, 8^h 47^m — 10^h 47^m P.S.T.

Willard 5-inch lens.

southern stream. Twenty-four hours later, or forty-eight hours after the plate of June 6th, the plate of June 8th shows the end of the formation with one or two of the zig-zags still faintly visible at a distance of about 6°.6 from the head. From two plates taken with the Willard six-inch on June 6th at an interval of sixty-three minutes, the end of the great streamer shows a movement along the tail in the radius vector of 44 kilometers per second; in the interval of twenty-four hours between the plates of June 6th and June 7th the average velocity of the matter in the end of the streamer was 70.1^{km} per second; in the nearly equal interval between the plates of June 7th and June 8th the average velocity of recession along the tail for the same mass of matter was 91.2^{km} per second. Other interesting evidences of rapid motion along the tail are found in nearly the entire series from May 25th to June 3d. Measures have been made of the more striking features on these plates and are tabulated below in the order of their distances from the head, the unit being the Earth's distance from the Sun. This table is admittedly only preliminary; there are numerous other formations on the plates besides those measured; time has not yet permitted, however, the definitive working through of the large amount of material available for the study of the velocities along the tail. For this reason a discussion of the motions observed and the acceleration will be withheld for more definitive treatment later. These preliminary results are ample, however, to show the increase in velocity as the matter recedes from the head. In computing these velocities the tail has been assumed to be in the prolongation of the radius vector; the determination of the hyperbolic orbits of the matter will, of course, change these values.

TABLE OF VELOCITIES ALONG THE TAIL.

Date	D (limits)	D	Interval	Velocity, kilometers per second
May 23	....	0	$3{,}000^{\mathrm{s}}$	0.9
May 13-14	0.0018-0.0046	0.0032	86,670	4.9
May 27-28	0.0005-0.0080	0.0042	86,880	12.8
May 25-26	0.0043-0.0157	0.0100	88,260	19.3
June 2-3	0.0055-0.0239	0.0147	86,520	31.8
May 28-29	0.0080-0.0292	0.0186	86,190	36.8
May 31-Jun. 1	0.0095-0.0287	0.0191	86,220	33.3

Date	D (limits)	D	Interval	Velocity, kilometers per second
June 6[1]	0.0230-0.0237	0.0234	7,200?	48±
June 6	....	0.0237	3,180	43.8
May 26-27	0.0157-0.0383	0.0270	88,020	38.4
June 6-7	0.0236-0.0640	0.0438	86,070	70.1
June 7	....	0.0640	3,630	53.6 (doubtful)
May 30-31	0.0501-0.0922	0.0712	86,670	72.4
June 7-8	0.0640-0.1170	0.0905	86,700	91.2

The following are the lengths of tail as determined from the photographs on a few of the dates:—

				Miles	
1909,	Dec.	16	3′	= 430,000	
1910,	Jan.	28	1°	= 4,700,000	
	Feb.	4	1 .7	= 8,800,000	
	Apr.	21	4	= 9,200,000	
	Apr.	30	14	= 19,000,000	
	May	5	28	= 27,800,000	
	May	10	38	= 24,400,000	
	May	17	105	= 18,900,000	
	May	19	146	= 18,600,000	(visual determination)
	May	23	59	= 16,000,000	
	May	28	28	= 17,600,000	
	June	2	20	= 21,000,000	
	July	1	4	= 18,000,000	

On account of the moonlight, observations were suspended on June 12th and resumed on June 26th. The comet was last seen with the naked eye on the night of June 28th; its effective brightness at this time was not greater than that of a sixth magnitude star. Its continued activity at this time is noteworthy. On July 1st, when one hundred and forty one million miles from the Earth and one hundred and fifty-two million miles from the Sun, the tail was recorded on the lantern lens plate for about four degrees, corresponding to an actual length of eighteen million miles. The tail on this night showed as a broad fork with vertex at the head.

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[1] From comparison with Professor BARNARD'S Yerkes plate of same date, as published in the *Monthly Evening Sky Map* for July.

PASSAGE THROUGH THE TAIL.

This question cannot be decided definitively until measures have been made on the formations and shape of the tail, the acceleration derived, and the hyperbolic paths of the matter forming the tail computed. The Mount Hamilton series from May 23d to June 8th shows many evidences of motion; these formations, however, and this increased activity are doubtless due to the same matter which caused such extraordinary changes in Comet Morehouse, as shown by the wave-lengths obtained by Professor WRIGHT with the objective spectrographs. It will accordingly be unsafe to deduce the shape of the tail before May 18th from the motions observed later. There will be needed also a collation and comparison of all available visual observations from May 18th to May 22d at observatories in different longitudes. A few such observations are at present available and a brief summary of them may be of interest; the times are Greenwich Mean Time.

May 18.5 (Helwan). Tail to α *Equulei;* 8° wide at γ *Pegasi;* 2° wide at α *Equulei.*

May 18.6 (Johannesburg). Tail to θ *Aquilæ;* southern branch observed.

May 19.0 (Mt. Hamilton). Two branches; the northern and stronger has α *Pegasi* on its northern edge and is about 6° wide, passing over θ *Aquilæ* with a width of 4°; faint traces suspected on the other side of the Milky Way by one observer. The southern and much fainter branch is about 3° wide; passes just south of the "Y" in *Aquarius,* with α and β *Capricorni* on its two edges. Total width about 17°.

May 19.1 to 19.3 (Königstuhl-Heidelberg). Bishop's ring seen about Sun; twilight described as of unusual intensity and duration. Very strong Bishop's ring seen about Moon. Appearances described as somewhat similar to those seen after the eruptions of Krakatoa and Mt. Pelée.

May 19.5 (Helwan). Tail goes past θ *Aquilæ* to Milky Way; tapering; 15° broad at α *Pegasi.*

May 19.6 (Breslau). Two faint arcs of light observed to pass over northern sky; 3° to 4° wide; upper one brighter; details of positions and movements in *Astronomische Nachrichten,* 4414.

May 19.7 (Johannesburg). Tail fainter; nearly to Milky Way; 11° broad in *Pegasus;* a degree or two farther north than the day before.

May 20.0 (Mt. Hamilton). Tail much fainter than the previous morning; 12° broad in *Pegasus,* 4° in *Aquila;* could not be made out east of γ *Pegasi;* not bright at horizon; resembled a detached streamer; about 1° north of the position of the day before.

May 20.3 (Helwan). No tail visible in west.

May 20.6 (Helwan). Tail in east to Milky Way; 10° broad in *Pegasus.*

May 20.6 (Johannesburg). Tail very faint; 10° broad in *Pegasus.*

May 20.7 (Mt. Hamilton). Perhaps 20° of tail visible in west in strong moonlight and twilight. Recorded for several degrees on plates.

May 21.0 (Mt. Hamilton). No trace of tail in east.

May 21.2 (Helwan). Tail to 20° in west.

May 21.6 (Helwan). No trace of tail in eastern sky.

May 21.6 (Johannesburg). Faint broad tail seen in east by two observers; no trace seen by another observer.

May 21.7 (Mt. Hamilton). 20° to 30° of tail in west.

May 22.0 (Mt. Hamilton). No trace of tail in east.

These observations are in some respects contradictory, and data from the longitudes of Australia, New Zealand, and Hawaii will be awaited with interest.

In connection with the possibility of the passage of the Earth through a part of the tail, the following points may be considered:—

1. The tail was of more than sufficient length to reach to the Earth throughout the period from May 5th to June 2d.

2. In the period from April 1st to July 1st the cometocentric latitude of the Earth did not reach 8°. Hence the tail appeared nearly straight during this time, and any attempts to determine the curvature of the tail by projecting the formations on the orbital plane are subject to large errors. For the same reason the measured angular diameters of the tail during this period probably represent closely the angular width of the tail in a

direction perpendicular to the orbital plane, provided the tail was not in the form of a flat sheaf; the photographs, however, seem to indicate that the tail was, at least within 10° of the head, a roughly circular bundle of streamers before May 15th.

3. The angular distances from the head corresponding to 15,000,000 miles have been computed for plates between May 10th and 15th and between May 23d and 28th. The average diameter of the tail at this point, including formations apparently north or south of the main tail, was 1,400,000 miles. Any ordinary assumption as to lag should affect the results on each side of May 18th about equally; if, as seems probable, the tail was straighter after this date than before, owing to the presence of lighter material, the average diameter will be larger than the figure given.

4. The distances of the Earth from the plane of the comet's orbit were as follows:

May 17.5 G.M.T.	+ 552,000	miles
18.5	+ 65,000	"
19.5	— 417,000	"
20.5	— 901,000	"
21.5	— 1,392,000	"

5. For a number of plates before and following May 18th the position of the radius vector has been plotted upon the negatives; for plates taken on May 9th, 10th, 11th, and 14th the lag behind the radius vector at the point of probable meeting of Earth and tail was on the average 12,000,000 miles for the apparent center of the strongest part of the tail. On the Zeiss plate of May 15th the main branch of the tail is nearly 4° from the projected radius vector at 60° from the head; it would seem that this formation must have been north of the orbital plane. Two fainter tails are nearly in the radius vector. On May 23d and the dates following up to June 3d there are strong streamers of different material from that which composed the tail before May 18th, apparently subject to a much higher acceleration. These are situated nearly in the projected radius vector, the rest of the tail lagging to the north, leaving these strong formations as the southern edge of the tail. The average lag of the tail at a point approximately 15,000,000 miles from the head on May 23d, 26th, 28th,

and 29th was 7,000,000 miles. Manifestly these preliminary values may be subject to considerable errors, though the agreement of the different values obtained is quite close.

6. Several of the photographs before May 18th indicate fainter streamers preceding the main tail and lying nearly in the prolonged radius vector. The faint southern branch seen on the morning of the 19th (civil date), nearly parallel to and only 5° north of the ecliptic, was probably such an advance formation. It is quite possible that such a streamer may have touched the Earth, probably between May 19.0 and May 19.5, but the Earth must have passed considerably to the south of the main portion of the tail.

Professor INNES' suggestion in *Transvaal Observatory Circular,* No. 3, that the tail would be repelled by the light reflected from the Earth has been offered independently in letters received at this and at other American observatories. While theoretically some such action is possible, only about one fourth of the Earth's surface would have acted upon the part of the comet observed; from our knowledge of the relative intensities of sunlight and moonlight it is difficult to conceive how such action could equal the one-hundred-thousandth part of that exerted by the Sun; it is, moreover, controverted by the lag of the tail *toward* the Earth after the transit of the head. That so small a force could overcome the relative orbital velocity of the particles of over forty miles per second, bring them to a stop, and drive them away, disrupting the tail, is difficult to conceive on any theory, either of light pressure or electrical action.

I have in hand the computation of the orbits and the acceleration of the moving masses observed in the tail. Prints or positives, preferably from plates taken with portrait lenses during the period from May 23d to June 10th, from observatories differing considerably in longitude from Mt. Hamilton would be of great assistance in this investigation. I should be glad to receive such prints or positives, particularly from the longitudes of Europe, Africa, Australia, and Hawaii, in exchange for positives from the Mt. Hamilton series.